

Syllides eburneus, a new species, with notes on other members of the genus (Polychaeta: Syllidae) from the coast of New England and New Brunswick

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Abstract.—*Syllides eburneus* new species, is described from the subtidal zone of the southern Gulf of Maine and the intertidal zone of the northern part. Morphological data obtained from living individuals of *Syllides convoluta* Webster & Benedict, 1884, *S. benedicti* Banse, 1971, *S. longocirrata* (Örsted, 1845), and *S. setosa* Verrill, 1882 occurring in the region are presented to clarify discrepancies which have arisen from the use of fixation artifacts encountered in preserved specimens. The role of protraction and retraction in the location of the foregut in specific setigers is discussed. *Syllides setosa* Verrill, 1882 is accepted as a valid species, whose morphology has been misinterpreted.

The polychaete genus *Syllides* is commonly encountered in sandy interstitial environments in which there is little indication of anaerobic conditions, although there may be some silt or finely fragmented algal debris. Living individuals can be readily identified, and while many of the identifying characters can not be seen or clearly observed in preserved animals setation frequently is distinctive. *Syllides convoluta* Webster & Benedict, 1884, *S. benedicti* Banse, 1971, and *S. longocirrata* (Örsted, 1845) are found in the intertidal zone of the Gulf of Maine. *S. longocirrata* and *S. setosa* Verrill, 1882 (usually as *S. japonica* Imajima, 1966) have also been recorded from depths of 20–40 m, in environmental surveys in the region. A previously undescribed species has been encountered at depths of 7–30 m in Nahant Bay, Massachusetts, frequently in large numbers, and in the intertidal interstitial community in the Northern Gulf of Maine.

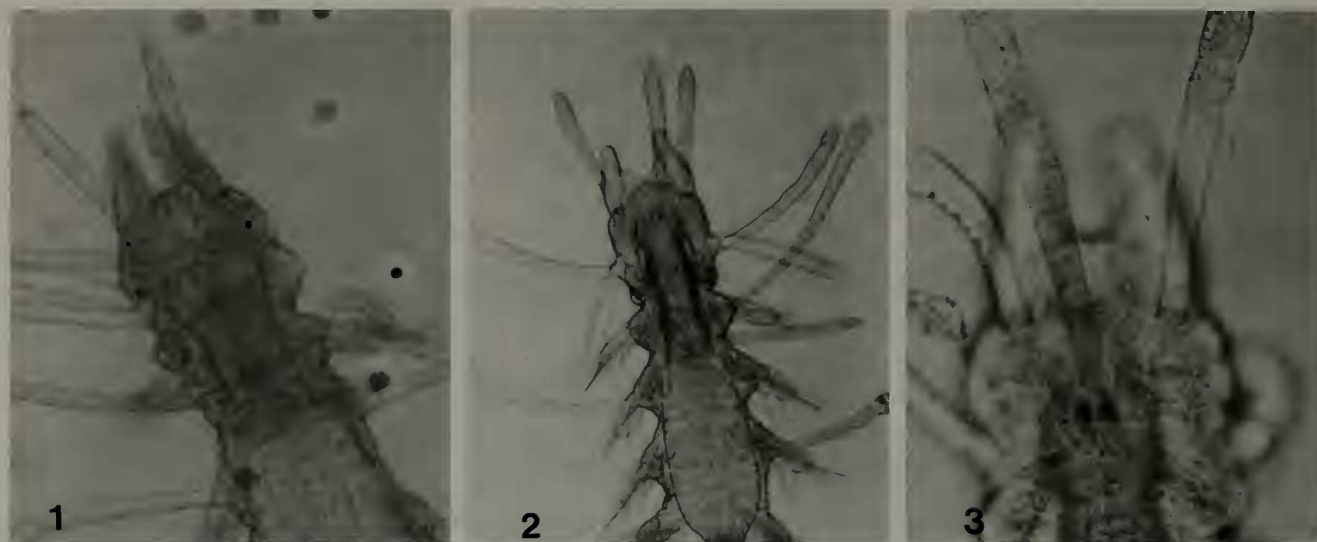
Materials and Methods

Specimens were obtained from sand collected for meiofaunal studies. Intertidal

samples were dug from coarse sand beaches with a garden trowel at low tide level during periods of extreme low tide. The subtidal samples were taken from the piles of sand kicked out from under rocks by lobsters digging retreats at depths of 7–40 m. Sediment was washed with fresh sea water and decanted onto 153 μm screens from which animals were removed for sorting. The sediment was then extracted with 7.5% MgCl_2 , and decanted onto the screens from which the animals were washed into fresh sea water. Specimens of the new species from the intertidal were not numerous, 3–8 per 8-ounce bag of sand. Subtidal samples yielded 15–35 individuals per 8 ounces, the largest numbers occurring at depths of 20 m. All measurements were obtained from living specimens.

Syllides eburneus new species
Figs. 1–5, 7

Diagnosis.—Small species attaining body length of less than 5 mm, up to 30 setigers. Prostomium hemispherical, slightly broader than long, projecting anteriorly beyond bases of lateral antennae. With two



Figs. 1–3. *Syllides eburneus* new species. Slightly compressed living specimens. 1, Optical section at level of posterior eyes, dorsal view; 2, Optical section of foregut region of immature specimen, ventral view; 3, Surficial dorsal view.

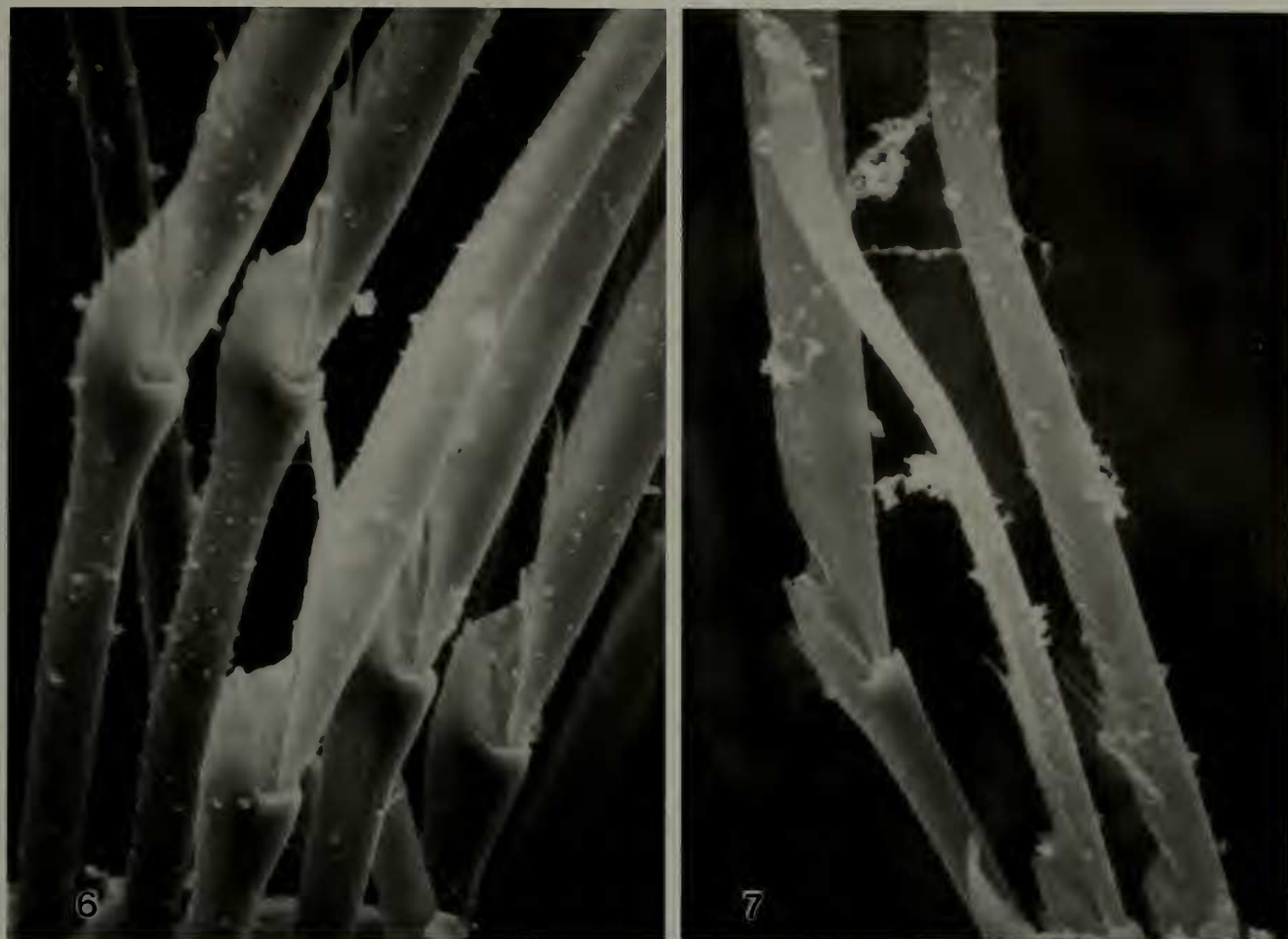
pairs of eyes, one pair at bases of lateral antennae, second pair approximately same size as anterior pair, at posterior ventrolateral corners of prostomium. Tentacular segment with many large greenish vacuoles. Antennae, tentacular cirri, and dorsal cirri of first three setigers, pseudoarticulate; dorsal cirri of following setigers with up to 14 articles, large ivory white vacuoles in each article. Antennae, tentacular cirri and dorsal cirri about same length, caudal cirri longer. Palps approximately same length as prostomium. Ventral papilla of palp digitiform. Pygidial stylus 16 μm long, with a stereocillium at either side of the tip. Ventral cirrus of each parapod digitiform, extending slightly beyond setal lobe. Aciculum tapered slightly to rounded apex; a thin,

curved, pointed aciculum also present in parapods of reproductive setigers. Simple setae denticulated on convex surface toward hemispherical apex (Fig. 4), usually only one per setiger, one or two thin, pointed, simple setae in last three setigers. Falciger blades unidentate, three to six in each parapod, in three distinct sizes, large blades $\sim 48 \mu\text{m}$ long, serrated at base, medium blades $\sim 36 \mu\text{m}$ long, shortest blades $\sim 14 \mu\text{m}$ long. Apex of shafts of falcigers sometimes with a subapical tooth. Shafts of falcigers and simple setae of first three setigers thinner than those of following setigers. Capillary (swimming) setae begin on setiger 10. Lips of pharynx nipple-like with large vacuole in base. Pharynx/proventriculus length ratio $\sim 1:1.4$, proventriculus width/length ratio $\sim 1:1.9$; ventriculus in 5 with no apparent caeca. Muscles of proventriculus thin, lattice-like, approximately 35 rows posterior to proventricular organ, muscles not in rows anterior to organ. Gonads begin in setigers 7–9; 1–2 yolky, pink ova, 65 μm diameter, per gonad; sperm 8 μm long, pear-shaped with pointed acrosome constituting about one-tenth of that length.



Figs. 4, 5. *Syllides eburneus* new species. 4, Apical end of simple seta; 5, Falciger blades and apices of shafts.

Etymology.—Latin *eburneus*, like ivory or ivory colored, from Latin *ebur*, ivory;



Figs. 6, 7. 6, *Syllides setosa*. Apices of shafts and bases of blades of falcigers, SEM $\times 4000$; 7, *Syllides eburneus* new species, Apices of shafts, and bases of blades of falcigers, SEM $\times 3600$.

referring to the ivory colored vacuoles in the dorsal cirri.

Holotype.—USNM 054107. Massachusetts; Nahant Bay, North side of Egg Rock. Coarse shelly sand; 10 m depth. 12 Sep. 1976.

Paratype.—USNM 054108. Same location and date.

Observations.—Antenna and tentacular cirri of living sexual individuals were 0.19–0.22 mm long. The dorsal cirri were up to 0.5 mm long with as many as 14 articles; the terminal article bearing scattered stereocilia at its apex, and each of the other articles with a ring of such cilia apically, and a single stereocilium in the middle of the posterior surface as is characteristic of other species of the genus. Caudal cirri tend to coil and attain lengths of 1.9 mm. They consist of a few long articles, rarely more than eight, usually six. Ventral cirrus (Fig.

2) of each parapod 57–76 μm long. The digitiform palpal papilla was 12–17 μm long with a few stereocilia scattered over the margin of the apex and was directed medially from the ventral edge of each palp near the palpal base. This structure is characteristic of *Syllides* species and was referred to by Webster & Benedict (1884) as a “short conical cirrus” in their description of *S. convoluta* and as “small projecting papillae” in the (1887) description of *S. longocirrata*. It appears to be a sensory structure incapable of use in food manipulation. The palps of preserved members of the genus usually form a funnel in front of the prostomium with the palpal papilla directed inward, but in the living state, they frequently flatten so that the papillae project laterally. Greenish vacuoles (gold or amber in transmitted light), concentrated in a collar behind the tentacular cirri (Fig. 3), are

characteristic of the genus. Frequently such vacuoles are also present behind the posterior eyes in the prostomium. The nuchal organs are present in a sulcus anterior to the collar. The thickened backs of the blades of the falcigers hook at the tip, but a subapical tooth is absent; the shafts are rather simple with the apical end extending as a single pointed prong sometimes with a subapical tooth (Figs. 5, 7) and the articular side with a flat termination that may be slightly elevated to either side. The ivory-white contents of the vacuoles in the antennae and dorsal cirri become transparent after a few days in specimens maintained in sea water, but can be used for preliminary identification while sorting fresh samples. The presence of two pairs of eyes (Fig. 1) is a primary character for the species (A posterior dorsal pair is absent), but in immature specimens, with fewer than 20 setigers, only the anterior pair of eyes (corresponding to ocelli) are pigmented. Gonads occurred from setiger 7–9 through 23–25 in specimens collected in October and November, with swimming setae beginning in setiger 10. The species seems to be an annual, breeding in late autumn and early winter. Intertidal specimens, collected in January and February at Liberty Point, Robbinston, Maine and Pagan Point, St. Andrews, New Brunswick, have consistently had fewer than 12 setigers.

Remarks.—The anterior pair of eyes of *S. eburneus* are always pigmented and relatively large, compared with the ocelli of most other species, and the posterior pair can be located on small immature specimens even though they may not be pigmented, but both pairs are pigmented and obvious in sexual individuals. *Syllides edentula* (Claparède, 1868), a Mediterranean species in which the dorsal cirri are not articulate, was described as having two pairs of eyes and the specimens from the Galapagos, tentatively identified as that species by Westheide (1974) only one pair. Westheide's specimens consisted of up to 12 setigers and some specimens were sexual. It

would appear that the Mediterranean *S. edentula* and that from the Galapagos are not conspecific. Preserved specimens of *S. convoluta*, in which the eyes have lost pigmentation, and preserved *S. eburneus* are difficult to distinguish without comparative material. Both species belong to the group of *Syllides* species in which the proventriculus is located in setiger 5, simple setae do not taper to a point, and when sexual, measure 3–5 mm. The two species are very similar. Variability of characters used to distinguish different species may “in reality simply represent intraspecific variability” as noted by Reish (1977), but the eye pattern and the pigment in the dorsal and caudal cirri is a constant found in intertidal and subtidal *S. eburneus*. These characters are not restricted to populations and appear to the author to signify separate species.

Protractors and retractors of the foregut occur as muscle stays running from the body wall to attachment points on the pharynx and proventriculus of syllid polychaetes as illustrated and described by Malaquin (1893). The fine stays involved with eversion of the pharyngeal tip are weakly developed in the genus *Syllides*, while the protractors attached to the base of the pharynx and proventriculus are strongly developed and draw back the body wall so that the proventriculus comes to occupy many or even all of the anterior setigers. The number of setigers occupied by the various regions of the foregut is not a fixed character, and in preserved specimens varies according to degree of contraction of the anterior body region. The stays (retractors) at the base of the proventriculus tend to fix the posterior location of the organ although it may be pressed into the ventricular setiger. Such compression against the intestine may bulge the ventriculus giving the impression that ventricular caeca are present. The ratio of length of pharynx to proventriculus can be affected by the amount of eversion or expansion (Fig. 1) of the pharynx, but the relative lengths are of use in distinguishing some sympatric species in which setation is

closely similar such as *S. benedicti* and *S. convoluta*. The proventricular organ is an elliptical epidermal gland containing a strongly azanophilous secretion which tends to harden and fracture in histological preparations. The intestine is fixed in position anteriorly, and thus, the ventriculus occurs in a specific setiger. The ventriculus occurs in setiger 5 of *S. convoluta* and *S. eburneus* and setiger 8 of *S. benedicti* and *S. longocirrata*.

Syllides eburneus is sympatric with *Ophryotrocha gracilis* Huth, 1934, *Schistomeringos caecus* (Webster & Benedict, 1884), and an eyeless species of *Protodorvillea* which are primarily subtidal species in the southern Gulf of Maine but are also commonly encountered in the intertidal of the northern part of the region.

Other Syllides species from the Gulf of Maine.—The method of collection of substrate does not allow for distinction between epipsammic and mesopsammic species. The various species of *Syllides* maintain themselves in the interstitial environment by wrapping around grains of sand, thus, few are encountered in the sea water rinses, and extraction with $MgCl_2$ is required. Substrate containing *S. benedicti* or *S. convoluta* routinely yielded 10–30 specimens per 8 ounce sand sample, thus over 100 individuals of each of these species have been examined and measured since the start of this study.

Syllides convoluta has been the most frequently encountered member of the genus in intertidal coarse sand between the southern shore of Cape Cod, Massachusetts and Georgetown, Maine. When freshly collected, the gut is dark purple to black in color, but in individuals maintained in clean sea water, it becomes reddish brown to tan. Fig. 3 of Banse (1971) is drawn from the syntype slides of *S. convoluta*. The membrane-like hood covering the tips of the acicula and simple setae is not apparent as a result of the clearing and mounting of these specimens. The apices of these structures in fresh, unfixed specimens tend to be round

as a result of the constriction of the shaft near the apex and the visible presence of the hood over the tip, producing a ball-like shape. Ridges in the wall of the hood (forming the apex in Banse's fig. 3b in which the hood is not apparent) are evident under high magnification. The ridges in the wall of the hood of the aciculum are weakly produced as in Banse's fig. 3a, making the ball-like appearance of the apex more pronounced. (Oil immersion is required to see these ridges in *S. eburneus* and even then, they are frequently not apparent due to the smaller diameter of the distal ends of setae and acicula in this species.)

Syllides benedicti Banse, 1971 is the dominant intertidal interstitial member of the genus North of Georgetown, Maine. Fig. 6h of Banse (1971) shows a "basal spur" which is actually the thickened margin of the cutting edge of the blade of *S. benedicti*. Beyond this thickened region, the edge is very thin. Serrations are not evident on any of the blades. There are four blade sizes, usually two small (15–20 μm long), one or two medium (27–29 μm), two with thickened ridge on blade (56–58 μm), and two or three large (64–70 μm). San Martin *et al.* (1985) ascribed material from the playa de Toja of Spain to *S. benedicti*; however, although the serrations on the blades could be interpreted as intraspecific variation, the length of the largest falciger blades, and the pharynx/proventriculus length ratio, indicate a distinct and different species. The simple setae of *S. benedicti* are similar to those of *S. convoluta* and *S. eburneus*. Ability to see the ridges at the apex is a factor of the relative diameter of that region, and thus, the ridges are pronounced in *S. benedicti*, obvious in *S. convoluta* and almost indiscernible in *S. eburneus*. The gut of freshly collected specimens of *S. benedicti* has been brown or tan. The muscle stays anchoring the intestine of *S. benedicti* originate in setiger 9. Gonads sometimes were observed in setigers 10 and 11, but in most sexual individuals first occurred in 12. Ova were pink.

In the type description of *Syllides setosa* Verrill, 1882, the "dark colored" pharynx is described as "apparently unarmed, but sometimes showing a pale, oblong spot, that might be taken for a feeble tooth." Hartman (1942) reported that the type material could not be found, however a portion of a specimen from the "surface, July 26, 1883" and identified by Verrill as *S. setosa* (USNM 10080) is available and was examined for the present paper. Emerton's drawing of *S. setosa* (Hartman, 1944 Pl. 24, fig. 11) shows a structure in the pharynx that has been interpreted as a tooth by various workers in spite of Verrill's statement. From time to time, Verrill mentioned in his papers that drawings accompanying some of his papers had to be corrected [apparently as a result of artistic license on the part of the illustrator as has been noted by Banse (1969) for the figure of *Acrocirrus leidyi* Verrill, 1882 in Hartman (1944), and is evident in the dorsal cirri, setae and setation, absence of palps etc, in Emerton's figure of *S. setosa*]. Palps are not present, the articles of the dorsal cirri are few in number, the basal article is almost half the total length of the cirrus, and capillary setae begin on setiger 8 in Emerton's figure. Verrill further stated that "simple long setae begin singly on the eighth or ninth setigerous segment; fascicles of capillary setae appear on the eighteenth segment in our largest example." Verrill described some polychaete species from the drawings as noted by Hartman (1944) and it is possible that he may have used Emerton's figure and inadvertently recorded eighteen instead of 8 in his description. However, neither 8 nor 18 seem to be correct. He stated that the description of *S. setosa* was "from life." At the end of the description, he mentions collecting specimens about 3 mm long "perhaps distinct from the above" with capillary setae beginning "on the tenth body segment." Banse (1971) noted that the simple setae of the specimens which he examined began in the first setiger and the capillary setae in the tenth as in the Nahant

Bay individuals. The benthic specimens from Nahant Bay have been taken routinely since 1976 between March and November at which time divers could be safely employed. Specimens with gonads have ranged in length from 3.2–11.5 mm. Morphological differences which could not be accounted for by size (age or growth) were not evident in any of the more than forty specimens which were measured or examined. Careful measurements using a calibrated ocular micrometer have yielded no measurable differences other than total length and breadth. Verrill's statement that the smaller epitokes might belong to a different species may be correct, however, it is possible that the species lives and grows through more than one reproductive episode or season, adding setigers after the initial spawning. The heavily pigmented pharynx is very black in specimens over six mm long which might be an indication of aging. The simple setae of *S. setosa* are geniculate, flexing at the origin of the denticulations. The denticulated side terminates below the apical tooth in such a way that the apex often appears to be bidentate. The denticulated side is thin, much like the cutting edge of the falcigers and the thickened back hooks at the tip forming the apical tooth. The cutting edges of the falcigers are very thin, but ridges resulting in fine denticulation are modified producing two or three "basal spines" (Fig. 6). Subapical spines on the shafts of the falcigers are not distinctly visible with light nor Nomarski microscopy, but are demonstrable with SEM (Fig. 6). Imajima (1966) figured strong subapical serrations on the falciger shafts of *S. japonicus* and comparable serrations are obvious on the Pacific coast specimen (USNM 45264) from Lopez Island, Washington identified by Banse (1971), and are distinctly figured by Westheide (1974) for *S. japonica edentula* and by San Martin et al. (1985) for *Syllides* sp. A. The notoacacula of *S. setosa* taper gently toward the apex which is expanded as a mushroom-like cap in dorsal and ventral view, but is flexed in

lateral view. A slender accessory aciculum occurs adjacent to the notoaciculum in each parapod from setiger 10 through the intestinal region. Single slender, tapered neuroacicula with rounded apices also occur in these parapodia. Intact dorsal cirri consist of up to twenty articles. The proventriculus is anchored in setiger 8, which is occupied by the ventriculus. Perkins (1981) furnished a table of characters recorded for the "*S. japonicus*" complex of species. He concluded that possibly five species were present, and that *S. japonicus* Imajima 1966 "perhaps should not be a member of the genus," with which I concur, since Imajima specifically stated that "a subterminal mid-dorsal tooth" was present in the pharynx. Unfortunately, this has never been confirmed. The sperm of *S. setosa* differ from those of other species in the present study in that the head is almost round, total length of head, about 4 μm and diameter slightly over 3 μm with a small pointed acrosome.

Syllides longocirrata has only been encountered in the intertidal of the Gulf of Maine at Pagan Point, along the seaward side of the causeway to Ministers Island, and at Joe's Point, St. Andrews, New Brunswick, in 25 years of routine meiofaunal sampling and has been associated with *S. benedicti* and *S. eburneus* at both locales. It falls into the same size range as *S. benedicti* and *S. setosa*, from which it can be readily distinguished by the distribution and morphology of the simple setae.

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